

Precision Tiltmeter as a Reference for Slope Measuring Instruments

Jonathan L. Kirschman, Edward E. Domning, Gregory Y. Morrison,
Brian V. Smith, and Valeriy V. Yashchuk

Lawrence Berkeley National Laboratory, Berkeley, California, 94720

The next generation of synchrotrons and free electron lasers require extremely high-performance x-ray optical systems for proper focusing. The necessary optics cannot be fabricated without the use of precise optical metrology instrumentation. In particular, the Long Trace Profiler (LTP) based on the pencil-beam interferometer is a valuable tool for low-spatial-frequency slope measurement with x-ray optics. The limitations of such a device are set by the amount of systematic errors and noise. A significant improve of LTP performance was the addition of an optical reference channel, which allowed to partially account for systematic errors associated with wiggling and wobbling of the LTP carriage. However, the optical reference is affected by changing optical path length, non-homogenous optics, and air turbulence. In the present work, we experimentally investigate the questions related to the use of a precision tiltmeter as a reference channel. Dependence of the tiltmeter performance on horizontal acceleration, temperature drift, motion regime, and kinematical scheme of the translation stage has been investigated. It is shown that at an appropriate experimental arrangement, the tiltmeter provides a slope reference for the LTP system with accuracy on the level of 0.1 microradians (rms). This work was supported by the U. S. Department of Energy under contract number DE-AC02-05CH11231.